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Worldwide Report

ENVIRONMENTAL QUALITY

No. 317

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ASIA

SUB-SAHARAN AFRICA

ENVIRONMENTAL PROTECTION WORK IN CHINA SURVEYED

Beijing and Shanghai ZHONGGUO BAIKE NIANJIAN 1980 [ENCYCLOPEDIC YEARBOOK OF CHINA, 1980] in Chinese Aug 80 pp 563-564

[Yearbook article: "Environmental Protection"]

[Text] State-Issued Environmental Protection Law

The 11th Session of the Standing Committee of the Fifth National People's Congress approved in principle the "People's Republic of China Environmental Protection Law (Experimental Implementation)." This is China's first environmental protection law. It rather completely and systematically specifies the directions, policies and principles for environmental protection work in China, the aspects of the environment subject to protection, basic requirements and measures, an environmental management system, and matters of scientific research, propaganda and education, and rewards and penalties. The purpose of the environmental protection law is to assure that during socialist modernization and construction the natural environment is used in a rational manner and that pollution and disruption of the environment are controlled and prevented, to produce a clean and suitable working and living environment for the people, to protect the people's health, and to stimulate economic development. The general aims of environmental protection work are: comprehensive planning, rational layout, comprehensive utilization, conversion of harmful things into beneficial ones, reliance on the masses, action by everyone, protection of the environment, and creation of benefits for the people. The fundamental spirit of this law is its requirement that all departments and areas, when drawing up plans for development of the national economy, also engage in planning for environmental protection and improvement and coordinated development; that existing factories and mines develop pollution control plans and conscientiously solve pollution problems; that environmental impact reports be made when constructing new enterprises ore renovating or expanding existing ones, which will be reviewed and approved by environmental protection departments and other relevant departments before the plans can be implemented; and that pollution control measures must be planned along with the main project and built and put into operation at the same time.

The promulgation of the environmental protection law gives great impetus to environmental protection work nationwide. Many areas and departments have drawn up specific plans and sets of measures. On the basis of relevant provisions of the environmental protection law, Jiangsu province has collected fees from enterprises and

units in the six cities or salt-producing regions of Nanjing, Wuxi, Suzhou, Xuzhou, Nantong and Taizhou for discharging wastewater, waste gases and solid wastes in excess of state standards, and in the case of some serious polluter enterprises it is experimenting with the use of economic measures to promote pollution control and environmental protection work in them. In addition, economic sanctions and the fixing of legal responsibility are being used in cases of serious pollution incidents. On 12 September 1979, the Suzhou City People's Chemical Engineering Plant was involved in a serious instance of pollution resulting from an overflow of sodium cyanide which killed large numbers of fish, shrimp and pearl mussels in some communes and state-run fish farms in Suzhou City and Wu County. On the basis of provisions of the environmental law, the Suzhou City intermediate level People's Court held a public investigation into this case of pollution, sentenced the guilty party to two years in prison and disciplined the main leadership of the plant.

Investigation of the Relationship Between Environmental Pollution and Hum Health

In order to investigate the effect of marine pollution on human health and the relationship between atmospheric pollution and lung cancer, in 1978 and 1979 respectively the Ministry of Public Health organized the Institute of Hygiene, Chinese Academy of Medical Sciences, and relevant province and city public health offices to pursue this work.

Liaoning, Hebei, Shandong and Jiangsu Provinces and Tianjin City are participating in the research on the effects of pollution in the Yellow Sea and Bohai on human health. For the past 2 years they have been pursuing a 5-year regression study of deaths from tumors, a survey of the disease rate and a survey of child growth and development and have been determining the content of such heavy metals as mercury, cadmium, lead and arsenic in human hair and urine and in marine products and seawater. Some provinces and cities have also determined the quantities of organic chlorine-containing pesticides in human fat, obtaining 200,000 units of data. The preliminary results of the investigation indicate that the mercury, cadmium, lead and arsenic levels in the bodies of fishermen along the coastline of the Yellow Sea and Bohai are higher than those in peasants in corresponding areas, with the mercury and cadmium levels being particularly elevated.

Some 22 cities are participating in research on the relationship between atmospheric pollution and the incidence of lung cancer. They have started with an analysis of the concentrations of harmful substances in the atmosphere, a regression analysis of the tumor death rate, an epidemiological survey on the incidence of lung cancer and a death rate survey. Both of the projects described above are continuing.

Pollution Control in the Bohai and Yellow Sea

In September 1977 the State Council's Environmental Leadership Group and the State Capital Construction Committee held a joint special meeting dealing with the serious state of pollution of the Bohai and Yellow Sea; with the authorization of the State Council they officially established a leadership group on environmental

protection in the Bohai-Yellow Sea region. In the last 2 years, the relevant departments, four coastal provinces and one city and their plants have made a major effort to prevent environmental pollution. By the end of 1979, more than half of the 200-plus pollution control facilities that had been arranged had been completed and put into operation. The Ministry of Petroleum's Chengli, Dagang and Liaohe Oilfields and the Offshore Petroleum Management Office have set up 17 new wastewater treatment plants so that the treatment rate for oil-containing wastewater has surpassed 90 percent. They have also actively promoted wastewater recycling measures, so that the recycling rate has surpassed 50 percent, thus both economizing on water use and improving oil extraction rates. The Jinxi No 5 petroleum plant used to be a serious polluter, and had many instances of oil leakage and fires on the river surface; subsequently it organized a group and reformed its management system, segregated wastewater from clean water and installed such treatment equipment as oil separators, flotation equipment, aerators and sand filters, not only improving the environment but recycling more than 20,000 tons of petroleum pollutants in 1979. The communications departments intensified their management of pollutant discharge by ships and boats, established trash recovery and wastewater treatment stations in such harbors as Dalian, Qinhuangdao and Qingdao, and recovered 38,000 tons of waste petroleum in 2 years, while collecting more than 8.3 million yuan in wastewater and trash handling fees. The Jinxi Chemical Engineering Plant modernized the production process in its electrochemical shop, decreasing its annual discharge of metallic mercury by 10 tons and producing a significant decrease in the mercury content of the water in Jinxi Bay. In addition, a monitoring network was set up, centered on the Marine Environmental Protection Institute of the State Oceanographic Office, 145 monitoring stations were established on the Bohai and Yellow Sea, and constant monitoring work was conducted. Scientific research units dealing with the seas, aquatic products, public health and the environment also carried out studies on the effect of marine pollution on human health, and on aquatic resources and the ocean's capabilities for self-purification through dilution, furnishing scientific data for comprehensive protection of the marine environment from pollution.

Pollution Control in the Guanting Reservoir

The problem of pollution of the Guanting Reservoir was jointly handled by Hebei and Shanxi Provinces, Beijing and Tianjin Cities and relevant departments of the State Council. The water quality has already improved, and the content of phenols, cyanides, mercury, arsenic and chromium has begun to decrease, with the vast majority of these substances now falling below state water quality limits for drinking water. The growth of fish and other aquatic life in the reservoir is excellent, and unfavorable symptoms in inhabitants near the original reservoir area are decreasing.

As the national economy developed, many factories and mining enterprises were set up upstream from the Guanting Reservoir; most of them discharged untreated wastewater into waterways, which found its way into the reservoir, causing a marked degradation of water quality. The State Council was much concerned about this state of affairs and took positive steps to control it. By 1979, the state had arranged for 77 treatment facilities, and the relevant provinces, municipalities and plant and mine enterprises had installed 26 facilities. On the basis of

statistics from nine of the facilities, these treatment installations recover and utilize more than 6,700 tons of such chemical products as benzene, methyl alcohol and oxalic acid, with a value of more than 2 million yuan, from the "three wastes" every year.

In addition, the relevant departments have set up five monitoring stations on Guanting Reservoir and in associated prefectures and cities, have focused on installing wastewater chemical laboratories and providing special chemical testing personnel, have created a water quality monitoring network for the drainage area, and are performing regular monitoring at specific points so as to keep aware of changes in water quality.

Lanzhou City's Efforts to Control Atmospheric Pollution

The Gansu provincial party committee and the Lanzhou municipal party committee accorded full seriousness to controlling air pollution in Lanzhou City and took energetic steps. They organized the allocation and transport of smokeless coal for the inhabitants as a replacement for smoke-producing coal, placed suitable limitations on the sulfur content of coal for use in boilers and accelerated boiler modernization, so that the number of modernized boilers citywide in 1979 was 62 percent higher than in 1978. In November 1979 the relevant departments of the Lanzhou Municipal Government decreed that all installations which discharged harmful gases or flyash should be modernized and should use control and recovery measures on the waste gases; all facilities which had not instituted pollution control by the deadline must stop production and institute such controls, and economic sanctions would be applied. In addition, 8 plants which were serious polluters and which were located in densely populated residential districts were moved outside the municipal area. After 2 years of pollution control, Lanzhou City's atmospheric pollution situation has already improved markedly. According to determinations at Nanguan, Chengguan Ward, the average daily dust concentration in the winter of 1979 was 53 percent lower than in 1978, and the average daily sulfur dioxide concentration was down 40 percent from 1978, but still exceeded state standards.

Deadlines for Pollution Control Measures in Seriously Polluting Factories and Mines

The "three wastes" discharged by factories and mines are the main source of environmental pollution. In order to gradually solve the pollution problem, in October 1978 the State Planning Commission, the State Capital Construction Committee and the State Council's Environmental Protection Leadership Group identified 167 plants that were rather serious pollution sources, including the Panzhihua Steel Company, the Baotou Steel Company, the Maoming Petroleum Company, the Lanzhou Chemical Engineering Company, the Jilin Chemical Engineering Company and the Dalian Dye Plant, as the first group of organizations to be assigned a pollution control deadline. These plants were told to intensify their leadership, to take energetic steps, and to achieve the pollution control requirements by the deadline; those which had not instituted pollution control by the deadline were to be resolutely shut down and would not be able to resume production until they had solved their problems, in addition to which the responsibility of the enterprise leadership and the upper level cognizant departments would be determined. After

the notification was issued, many of the plants took active pollution control steps which yielded an effect. For example, the Jiapigou Gold Mine in Jilin Province originally used the amalgam method of gold purification, and when the plant was built no tailings dam was put in, so that large quantities of mercury-containing tailings were discharged into the Songhua River. Within only 9 months after this mine came under the pollution control deadline it installed a tailings dam, and the mercury content of the tailings water is already below state discharge limits. The flyash discharged by the Taiyuan Iron and Steel Company's oxygen converter and the high-phenol-content wastewater discharged by its coking plant were two major pollution problems in Taiyuan City, about which the masses complained vigorously. These two units intensified their leadership, and organized a decisive battle, and after 4 or 5 months of effort they finished installation of a phenol-removal facility at the coking plant and overhauled the converter's "red smoke" cleaning and recovery equipment, stopped using problem flues, and solved their long-standing, perplexing problem. The phenol removal efficiency surpassed 90 percent and the dust removal rate from the "red smoke" was over 99.4 percent, in addition to which every year it is possible to recover large quantities of chemical engineering raw materials and highly concentrated ore powder.

Participation in Worldwide Environmental Monitoring

Starting in 1979, China has been participating in the International Environmental Monitoring System and the Work of the International Latent Poisonous Chemical Products Recording Office.

The International Environmental Monitoring System is an organization for monitoring worldwide pollution trends which is run by the United Nations Environmental Planning Office, with the World Health Organization in charge of specific work. Currently more than 100 countries and territories worldwide have joined the system. The participants' task is to share environmental monitoring data with the system. After China joined the system, the Ministry of Public Health took on this work; external liaison and technical guidance related to the work are managed by the Public Health Research Institute of the Chinese Academy of Medical Sciences. China's first group of participating water quality monitoring stations are: the Hubei section of the Yangtze River system, the Shandong section of the Yellow River System, the Guangdong section of the Pearl River System, and Taihu Lake in Jiangsu Province. Shanghai, Shenyang, Guangzhou, Xi'an and other cities have atmospheric monitoring stations. The various provinces' public health offices are in charge of the monitoring stations' work.

The International Latent Poisonous Chemical Products Recording Office is a component of the United Nations Environmental Planning Office's World Environmental Evaluation Program. In China, the Institute of Public Health, Chinese Academy of Medical Sciences is in charge of this work.

8480
CSO: 5000/4074

AFFORESTATION DRIVE BEGINS IN BEIJING

OW101306 Beijing XINHUA in English 1236 GMT 10 Jul 81

[Text] Beijing, 10 Jul (XINHUA)--The Beijing municipal bureauof forestry plans to afforest 16,600 hectares of land surrounding the city in a 15- to 20-day drive during this summer's rainy season, the bureau said today. The afforestation will be done partly by air sowing, only the second time in Beijing.

The drive is intended to combat the dust storms that rage through the Chinese capital every year and which appear to be growing worse. The forestry bureau says the storms contribute significantly to air pollution in the city, increase water evaporation from the soil and destroy crops. The bureau has called for protection of the existing forests around Beijing and the planting of a shelterbelt around the city. Beijing is subject to winds from the Siberian north and the Mongolian desert and loess plateau to the northwest. The winds enter the city through three wind gaps in the nearby mountains.

Guan Junwei, a professor at the state-run forestry institute, said the storms are getting worse because of the expansion of these desert areas. He cited a 40 percent increase in the desertified area along the lower reaches of the Tarim River in Xinjiang Autonomous Region. Nearly 50 percent of a pasture in Inner Mongolia has been desertified as against 12 percent 10 years ago, due to overgrazing and faulty farming policies that resulted in ruination of pastures.

Another reason for the dust is the extremely low proportion of plant cover in and around the city itself. Forest cover rose last year to 7.5 percent of the 1.66 million hectares of Beijing's total area. Green area in the downtown area has risen from 700 hectares to 3,000 hectares. However, the bureau said, this was not enough to offset the effects of the storms. The average number of dust-storm days increased 11.4 from 14.6 between the years of 1969 to 1973 to 26 between 1974 and 1980. Already in the first half of this year, said the bureau, there have been 17 dust-storm days. The municipal forestry bureau has drawn up a comprehensive program of afforestation since its establishment last August. Beside the 16,600 hectares around the city slated for planting in the next 2 to 3 weeks, another 16,000 hectares will be planted in the fall, making nearly 33,000 hectares to be greened by the end of the year. That is 9,000 hectares more than last year. A total of 600,000 square meters of grass will be planted inside the city by the end of the year. The bureau has also called for a program to control the growth of desertification and soil erosion in north and northwest China.
CSO: 5000/2151

BANGKOK'S SINKING AREAS SPREAD

Bangkok THE NATION REVIEW in English 22 Jun 81 pp 1, 8

[Text]

AREAS IN CENTRAL Bangkok which have been sinking by an average of five to ten centimetres annually have spread significantly in the past three years, according to the latest official survey carried out recently.

An investigation on "land subsidence" of Bangkok has been jointly conducted by the Asian Institute of Technology (AIT), the Royal Thai Survey Department and the Thai Department of Mineral Resources under a research contract granted by the Thai National Environment Board.

"On the basis of a mathematical model, it is predicted that an annual rate of surface subsidence ranging from 1.2 to 7.2 cm annually, with a total subsidence of 1.4 to 2.1 metres by the year 1995," according to the outcome of the survey quoted in a report by Dr Prinya Nutalaya and Dr Jeravak Premchitt of AIT's Division of Geotechnical and Transportation Engineering recently presented to the 26th International Geological Congress in Paris.

The joint study also forecasts that a probable ultimate subsidence of about two to 3.1 metres would occur on the assumption that the groundwater level drops from ten metres to 40 metres throughout the entire 600 metres of soil deposits, and that residual pore pressure is fully dissipated.

"The continuation of the land subsidence will cause the flooding in Bangkok to be more serious in the near future," the report says, adding that because of the low-lying ground surface of Bangkok, a large part of the city was inundated for several weeks in 1975, 1978 and 1980.

"The floods in the city disrupted traffic and communication systems, damaged buildings and pavements, created public health hazards, thus adding to great economic losses," the report says.

It also reports that "cumulative compression" of the clay layers has resulted in total land subsidence of about 50 cm and a maximum subsidence rate of more than 10 cm per year.

"A large number of buildings which rest on deep foundations are found to stand up against the subsiding ground surface and groundwater wells protrude as much as 50 cm above the ground surface," the report says, adding: "Subsidence has seriously aggravated flooding, drainage, and sewerage problems."

Bangkok is located on an "extremely" flat deltaic-marine plain with natural ground elevations ranging from 0.5 to 1.5 metres above mean sea level.

Pumping of groundwater from "aquifers" has been found to be the main reason for the "sinking phenomenon" of Bangkok.

According to the latest study, nine "aquifers" (layers of rock or soil able to hold or transmit much water) have been identified in the upper 550 metres under the city. Pumping of groundwater from these aquifers is over 1,000,000 cubic metres a day in 1980 from about 11,000 wells.

Groundwater has been exploited for various purposes in Bangkok for nearly six decades, the study notes. But a very sharp increase in groundwater development began in 1957.

The total extraction rate of both public and private wells is expected to continue to grow in the future although a large number of wells have been abandoned because of a large drop in water level and water quality deterioration, the report says.

The groundwater extracted has also been found to become more saline. At present, the report adds, the chloride content in many areas ranges from 500 to several thousand ppm.

The report says that from evidence observed by the AIT's Division of Geotechnical and Transportation Engineering in the past years, "it seems that the total subsidence in central Bangkok at present is of the order of half a metre."

During the past two years, at six-month intervals, the Royal Thai Survey Department has carried out precise levelling from mean sea level to the surface reference points installed in this investigation as well as to the existing benchmarks and those recently installed by the department.

"Based on these levelling results, it was found that the existing benchmarks in Bangkok are 30 to 80 cm lower than the

original elevation survey-ed 30 to 40 years ago," the report says.

Before the investigation was launched, predictions of land subsidence in the Bangkok area had been made on the basis of the compression characteristics of subsoils and the measured drops of groundwater level.

The report says that at present, there is no comprehensive plan to solve the subsidence problem in Bangkok.

"To prevent land subsidence in Bangkok, laws must ensure that groundwater pumpage is controlled because no further decline in groundwater levels can be tolerated," the report says.

It suggests that in order to reduce the overall rate of groundwater pumpage, more surface water supplies should be sought and developed. The surface water system will have to be expanded and extended to cover the area of high subsidence, where the public water supply is inadequate.

"The groundwater resources should also be replenished by artificial recharge. The possible recharge alternatives need further examination and tests before they can be efficiently implemented in the Bangkok area," the report says.

The ground surface elevation in Bangkok is not accurately known in detail since there is no systematic network of benchmarks in the area and no regular survey was conducted in the past.

"This lack of information makes it impossible to devise an adequate drainage and flood protection system," the report says, suggesting that a detailed ground surface elevation map should be prepared every year.

"In this way, the low-lying areas can be identified and the drainage and flood protection systems can be designed."

CSO: 5000/4531

POLITICIANS, POACHERS CONSPIRING IN ONGOING DESTRUCTION OF FORESTS

Bangkok BANGKOK POST in English 26 Jun 81 p 2

[Article by Supradit Kanwanich]

[Text]

THAILAND's top conservationist yesterday charged politicians with "corrupting the national treasure" by encouraging villagers to cut down forests in a bid to win votes.

In an interview with the Bangkok Post, Secretary General of the Association for the Conservation of Wildlife Dr Boonsong Lekagul said that politicians were indirectly contributing to the depreciation of Thai forest. "Each year between 1973 and 1978 were cut at the rate of 1,117 square kilometres a year.

He said only 27.6 per cent of the country consisted of forest area, as against 34.15 per cent in 1978, and if the present pace of cutting continues, all the forests will be gone within 20 years.

"The suppression of log-cutting is not effective because politicians charge the forestry officials with contributing to the hardships of the poor whenever they try to stop the poaching," Dr Boonsong said.

He charged that some politicians even encourage the villagers to destroy the forests for cultivation because they want to win votes in future elections. "That is a clear corruption of our national treasure," he said.

He added that reforestation programmes, which can cover only 640 square kilometres every year, were being hindered by the same villagers who first cut the forests and then prevent the officials from replanting the areas, saying they were doing so on their land which had already been classified as destroyed forests.

Dr Boonsong said forests were being cut by illegal poachers and by villagers to make charcoal or gain land for cultivation. They are being cut to gain mining concessions, build roads, convert into resettlement areas and reservoirs — all on government request.

Even estimates of 27.6 per cent of the country being forest area is conservative, Dr Boonsong said. The figure could be less than 20 per cent in view of the rampant destruction still raging at the hands of poachers and the slash-and-burn culprits.

Over the last five years, forest destruction has brought about a marked change in the country's ecosystem, he said. Humidity levels rose because there were no longer enough trees to absorb the moisture in the air, soil erosion continued unchecked and many species of animals lost their main forms of shelter, endangering their existence.

He said if forest destruction continues, the gaur would be extinct within 10 years and the wild elephant in 30 to 40 years.

CSO: 5000/4531

THIRTY-FIVE PERCENT OF LAND IN NORTHEAST TOO SALINE FOR PLANTING

Bangkok SIAM RAT in Thai 11 Apr 81 p 2

[Text] Mr Wira Musikphong, deputy minister of agriculture and cooperatives discussed the matter of development of salty land in the northeast. He said that this matter is a policy of the prime minister. It is felt that Mahasarakham and many provinces in the northeast are plagued with this problem and the land is not suitable for cultivation or for increasing production. The matter has been assigned to the Ministry which will draw up a master plan for the development of salty land. The Ministry has assigned the Land Development Department to do a survey and set up projects. It has been discovered that saline soil is not restricted to Mahasarakham Province, but afflicts nearly every province. It covers approximately 34.96 percent of the total area of the northeast. It is therefore an important problem which must be urgently remedied and has been designated as an urgent project which the cabinet has approved. The project for correction of saline soil has been included in the National Economic and Social Development Plan, Phase 5 for 1982-1986.

The deputy minister of agriculture and cooperatives further stated that this program involves the development of saline soil [as published] in various locations totalling some 4 million rai. The project will be divided into four operations sectors. Most of the project will be in Mahasarakham and Nakhon Ratchasima provinces. It will start in October of this year. Implementation will be divided into two plans: a plan to prevent the spread of salinity and a simultaneous treatment of saline soil. The other plan is to raise yields of crops planted in saline soil. This will enable us to halt the spread of saline soil. In implementing these plans, it may be necessary to invoke laws which concern enhancement and conservation of the nation's environment. These laws are tools to be used in remedies for and prevention of saline soil. One important reason for these laws is that the spread of saline soil comes from the operation of salt works. Any area operating a salt works will have a greater spread of saline soil.

CSO: 5000/4532

OUTSIDE HELP ADVOCATED FOR ACCRA SANITATION PROBLEM

Accra GHANAIAN TIMES in English 23 Jun 81 p 8

[Article by Tom Dorkenoo]

[Text] Sanitation in Accra is fast deteriorating again.

A 'Times' investigation disclosed that human excreta and garbage have not been collected from Adabraka, Labadi, Nima and other parts of Accra for the past three weeks.

In Nima and Kanda, for instance, human excreta and refuse are being dumped at every available empty space.

At Labadi, the refuse dump opposite the Labadi Presbyterian Church is about four metres high and the nearby public place of convenience has overflowed the septic hole and has linked up with the piled-up garbage.

At Teshie, Nungua, Bubiashie, Accra New Town and Maamobi, the story is no different.

The beaches of Labadi and James Town are full of refuse and human waste.

Investigations also revealed that though the officially declared refuse collection depots number 71, not less than 129 more had been unilaterally created "by the people" who are compelled by lack of space to "dump and burn" their refuse at any other spot.

The number of temporary refuse dumps has also increased from 26 to more than 60, for the same reason.

Meanwhile, two senior employees of the Accra City Council and a former councillor have attributed the sanitation problems to "the poor sense of responsibility on the part of senior officers of the council, sepecially the MOH and the Fleet Maintenance Unit of the City Engineer's Department".

They called for the services of foreign consultants to advise the City Council on both refuse and waste matter disposal methods as was the case of Lagos City Council in Nigeria.

Lagos, they pointed out, was until recently, "the dirtiest city in the world", as declared by the World Health Organization (WHO), but the administrators of that city realized their inability to cope with the sanitary problems and called in outside help.

"This should be done for Accra City too", suggested the concerned councillor and ex-council staff.

Sources close to the Census Office told me that Adabraka, with a population of 37,836 in 1960, is now over 50,000 and that Labadi, which in 1960 had 25,939 residents, now has over 55,000.

A spokesman for the Medical Officer of Health's (MOH) Department of the ACC told the 'Times' that over 600 tonnes of all kinds of refuse had to be collected every day and that its collection and disposal efforts were being made difficult by acute shortage of vehicles.

CSO: 5000/5039

REFUSE, LITTER CREATE UNSANITARY ENVIRONMENT

Accra DAILY GRAPHIC in English 11 Jun 81 p 1

[Excerpts] Parliament has urged the Limann Administration to mobilize all available resources to improve upon the insanitary conditions in the country.

Some MPs recommended that the Administration should reduce its dependence on conservancy labourers and other personnel connected with sanitation to check the frequent demand for salary increases.

It was suggested that the Administration should seek financial assistance to complete the central sewerage system in Accra.

In a motion, Mr A.A. Abanyie (ACP, Cape Coast) registered his profound disgust at the filth especially in the towns and cities. He referred to the unhygienic conditions at the Kotoka International Airport as "shameful."

He appealed to all to help bring the situation under control. The MP urged the Administration to provide city and district councils the needed inputs to help them intensify their work.

Seconding the motion, Mr Kwame Adum Atta (PFP Deputy Chief Whip) suggested that the cities must be categorized into smaller units of administration to enable them to cope with the sanitation problems.

In his contribution, Dr Jones Ofori-Atta (PFO Beogor) said the Environmental Protection Council (EPC) should be encouraged to keep the environment clean because "healthy environment is an essential factor to the health of man."

In his contribution, Mr P. O. Anala (PNP Sandema) said Ghanaians must learn to live with clean habits because "dirt is created by man and nobody should delight in wallowing in dirt."

CSO: 5000

BRIEFS

HUNDREDS HOMELESS FROM FLOODS--In the Rivers State, hundreds of people have been rendered homeless following heavy rains in [name indistinct] District in (Enuguare) Local Government Area. According to reports, many buildings have been washed away with property estimated at (?7 million) naira damage. In the meantime, relief operations organized by the urban district council has begun. The chairman of the council, Chief Elem Kawumpa, has appealed to the state government for aid. [Text] [AB212133 Lagos Domestic Service in English 2100 GMT 21 Jul 81]

FARMLAND LOST FROM EROSION--A total of 616,622 hectares of arable farmlands in Gongola State are feared to have been devastated by the menace of soil erosion within the past two years. Although the amount needed for the effective control management and conservation of susceptible landmass reclamation, resettlement as well as compensation to the displaced persons has not yet been computed, it is believed that it would run into millions of Naira. The Commissioner for Agriculture and Co-operatives Alhaji Abubakar Mutum Biu, said in an interview that soil survey and land evaluation was conducted by an international agency, government organisations and professional bodies. According to the reports of the various surveys, Alhaji Abubakar explained, gully and flood erosion had been recorded in all parts of the state particularly along river banks, valleys and numerous mountains. [Text] [Kaduna NEW NIGERIAN in English 23 Jun 81 p 24]

CSO: 5000/5034

BRIEFS

INADEQUATE ANTIPOLLUTION ENFORCEMENT--Many industrialists in South Africa are taking advantage of the Government's acute shortage of air pollution inspectors by dumping enormous quantities of dangerous wastes in the air. "At the moment the Government has hardly enough inspectors to control an industrial town, let alone an industrial nation," Mr James Clarke, head of the Star's CARE campaign, told a three-day national workshop on "Dust Control in Industry" at the University of the Witwatersrand today. South Africa's air pollution was "probably as bad as the worst found in advanced nations today," he said. "Our laws are manifestly inadequate. They allow municipalities to hound home-owners with R50 spot fines for lighting bonfires but only the Government can fine industry. The fines--R200 for a first offence and R1 000 maximum for repeated offences--are hardly likely to persuade industrialists to spend millions on clean air equipment." Wind-blown mine dust gave the Rand the world's highest incidence of ear, nose and throat complaints. [Text] [Johannesburg THE STAR in English 8 Jul 81 p 2]

CSO: 5000/5037

MATEPPE ESTATES IRRIGATION SCHEME OPENED

Salisbury THE HERALD in English 17 Jul 81 p 1

[Text] Commercial farming is vital to the national economy and the Government will encourage it to exist side by side with peasant agriculture, the Deputy Minister of Agriculture, Dr Swithun Mombeshora, said yesterday.

He was opening the second $150,000 irrigation scheme at Mateppe Estates in Marandellas. The new scheme brings a total of 440 ha under irrigation at the estate and will mean optimum use of all available arable land, including 260 ha of maize, 90 ha of wheat and 90 ha of vines.

He said the Government would like to improve the living standards of all the people, produce sufficient food for all and make Zimbabwe the "granary of Africa."

BONUS

He noted that the recent wheat producer price schedule included a bonus of $25 a tonne for grain deliveries in excess of those made last season, in a measure aimed at stimulating wheat production.

There had been great expansion in irrigation in the Marandellas area. In 1970 the area under irrigation was 1 851 ha, compared to 6 499 this year.

During the same period, there had been an increase in maize production of 40 percent and a 30 percent increase in tobacco yields. At the moment 46 percent of the crops in the area were grown under irrigation.

Mr Tony Knight, managing director of Cairns Holding Ltd, which owns the estate, said it planned to spend about $200 000 next year on an expansion programme involving an increase in the acreage of all crops grown on the estate.

The minister later toured the wine factory and tasted various types of wines produced from grapes grown on the estate.

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ECOLOGICAL-ECONOMIC MODELS FOR PLANNING, MANAGING STATE OF ENVIRONMENT

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[Text] According to present-day general genetics, the state of the biosphere depends to a significant degree on the kind of genetic information which organisms have inherited from previous generations. At the same time it has been established that many environmental pollutants are capable of causing mutations (changes in the genetic information), which can lead to undesirable consequences. In particular, having destroyed today a portion of the planet's gene pool, in the future we shall lack the opportunity to manage the biosphere for purposes of increasing its stability and productivity, and this in turn will have a negative effect on the maintenance of the public's food supply.

The scale of the genetic effect is determined not so much by the absolute magnitude as by the duration of the influence, which may result from moderate or even very weak concentrations of harmful ingredients. At the present time hygienists and toxicologists have at their disposal a methodology which is oriented mainly towards the establishment of the absolute effects of pollutants on living organisms. Accordingly, the existing practice of environmental protection planning is based on an industry-by-industry approach, which is limited to monitoring the primary forms of pollution. The indicators which characterize environmental quality are calculated but are not accepted as plan targets. This is obviously inadequate for a number of reasons. In the first place, long-range predictions of environmental changes resulting from industrial wastes are essential from the viewpoint of a global approach. It is natural that prediction of the consequences of pollution, taking into account the social, economic and ecological goals of society's development, is possible only under these circumstances. In the second place, it is necessary to have a system of evaluation and measurement which makes it possible to determine and to compare any given environmental states in terms of their social, economic and ecological aspects, as well as to set out the most promising ones from the viewpoint of the the global aims of directing its evolution. In the third place, there is now an urgent task of creating methods and means of planned influence on factors which cause environmental pollution in order to maintain the environment in a desirable state. In other words, it is essential to have

a system of ecological-economic planning and management, which would make it possible to make decisions which are coordinated according to at least two criteria: environmental quality and the number of benefits of natural or manufactured origin, the use or creation of which is related (in order to satisfy society's economic and social needs) to the current use of imperfect, wasteful technology.

In this article the primary attention will be devoted to the principles of constructing a system of ecological-economic models, the outlines of which were specified in [1,2]. We shall formulate those requirements for a system of ecological-economic models which guarantee, in our opinion, its applicability for the planning and management of environmental state from the viewpoint of a general approach to the solution of problems related to environmental pollution. The first of them is that it is necessary to encompass all cause and effect relations which exist in the ecological-economic system. The second is that the system of models must include closed loops which are formed on the basis of direct and feedback links between the elements of a real ecological-economic structure. The third requirement is that the total of the formal and informal criteria which make it possible to adopt coordinated decisions with regard to special purpose installations for the planned period acccording to environmental quality must also be balanced in socio-economic and ecological aspects. The fourth requirement is that the system must have formal and content-rich models for evaluating and choosing means and methods for maintaining the environment in a desirable state. The fifth requirement is that everything which is part of a system of ecological-economic models must be dynamic.

As has been noted, the models of the system must have coordinated inputs and outputs with models of an integrated system of planning and prognosis [3], as well as with certain other special models which will be discussed below. This kind of approach provides an opportunity to significantly simplify the structure of the system for ecological-economic models, to make the modelable relations more obvious and to eliminate the need to cite here individual models or those groups of models which are subjects of research in other branches of science and which are treated in the specialized literature.

In order to formulate a general concept of the the construction of a system of models we shall examine the cause and effect relationships in an ecological-economic system. The most important of these relationships are given in the schematic drawing.

The arrangement is based on the principle of differentiating from the aggregate of society's requirements two main groups: socio-economic and ecological requirements. These groups are differentiated according to the origin of the benefits which satisfy the corresponding needs. The first are satisfied by benefits of natural or production origin, the use and manufacture of which is organized by society and involves seeking out limited natural and labor resources. The requirements of the second group are benefits of purely natural origin which are obtained through the process of direct interaction between people and their natural environment (sunlight, clean air, etc.). Ecological requirements make definite demands on the quality of the surrounding natural environment. The level at which the requirements of both groups are satisfied

predetermines the presence and state of the labor reserves which can be used in production at a given moment.

The state of the environment depends on the flow of industrial wastes, i.e. of indestructible pollutants and in addition on their discharge during the process of utilization. However, the final concentrations of polluting substances are established during the processes by which they are moved and transformed within geo-biophysical environments.

The effect of production on the environment gives rise to a number of responses by the latter; their nature and operational mechanism is obvious. Thus, the ecological-economic system contains forward and backward links, which form in their totality a closed loop which must be taken into account when managing the state of the environment. This thesis makes it possible to isolate within this system the following main groups of models:

models of social production;
models of industrial effect on the environment (forward link models);
the dynamics of production factors under the direct and indirect influence of a polluted environment (backward link models);
advisory models.

We shall examine each of these groups individually, beginning with the second. This approach provides the opportunity for discovering the parameters which help to manifest the regulating effect of the environment on production and to set out the means for taking them into account in the models of social production.

Two types of models have been noted within the group of models concerning the industrial effect on the environment: the dynamics of industrial discharges and the movement of polluting substances. Models in the first group are designed to link industrial wastes with the process of production and actions to protect the environment; models in the second group are designed to link industrial wastes with natural processes. In the aggregate these models must make it possible to determine at each moment the pollution level, which is measured by the concentration of pollutants in individual components of the environment.

Assuming that the output of by-products is proportionally dependent on the gross output of useful products and the volume of destructible pollutants, the dynamics of industrial discharges for individual types of polluting substances can be represented by the aggregate of the differential equations

$$\frac{dz_q}{dt} = \sum_{j=1}^{n} b_{qj}x_j + \sum_{g=1}^{\bar{m}} b_{qg}v_g - y_q - \hat{y}_q, \quad q = 1, \ldots, m. \qquad (1)$$

where x_j is the gross output of useful product j; y_g is the volume of destructible pollutant of type g; v_q is the volume of destructible pollutant of type q; $\hat{y}_q$ is the volume of pollutant of type q which can be absorbed (detoxified) by the environment; b_{qj} and b_{qg} are coefficients which characterize the output of pollutants q per unit of useful product j which can be produced and per unit of destructible pollutant g respectively. The derivative in the left portion of (1) determines the rate of change in the discharge of pollutant q in time.

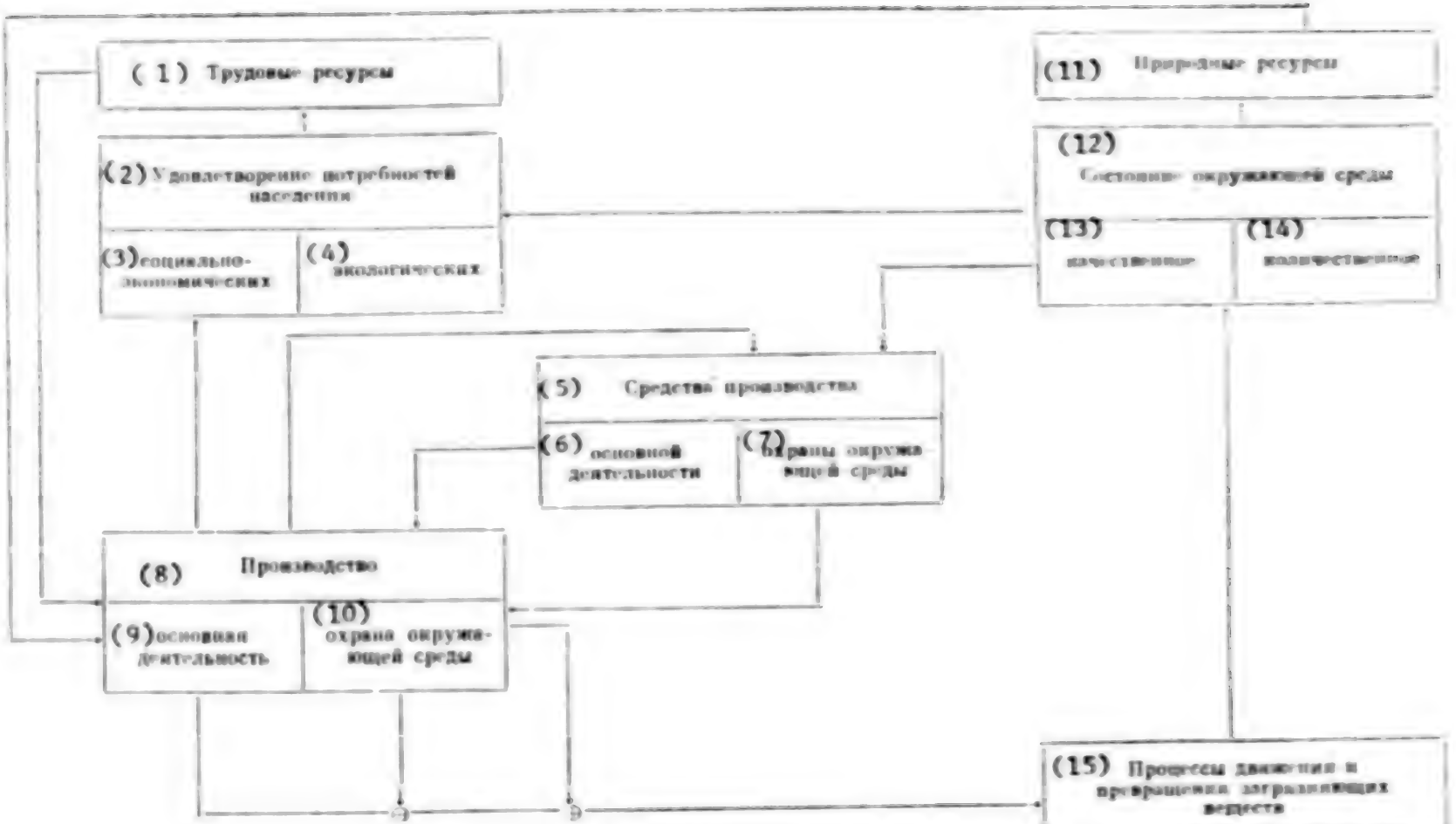

Схема основных связей эколого-экономической системы

Schematic of the Primary Links in an Ecological-Economic System

Key:
1. Labor resources
2. Satisfaction of public needs
3. Socio-economic
4. Ecological
5. Means of production
6. Essential activities
7. Environmental protection
8. Production
9. Essential activities
10. Environmental protection
11. Natural resources
12. Environmental state
13. Qualitative
14. Quantitative
15. Processes of movement and conversion of pollutants

In essence, equations (1) describe the subsidiary output of an economic system and make it possible to determine at every moment in time t the volumes of pollutants capable of movement and transformation in the environment. Calculating in the first approximation the coefficients b_{qj} and b_{qg} as constants, these volumes can be represented as functions of three variables, the first two of which (x_j and y_g) belong to the sphere of anthropogenic activities--social production--and the third ($\hat{y}_q$) characterizes the nature of the environment, and, it can be assumed, depends on its state.[2]

Under movement is understood change in pollutants, in the process of which they penetrate in a manner specific to each type from a component into a component of the environment. Along with movement which occurs under the influence of various environmental factors changes in polluting substances also take place as a result of which there can originate changes in their composition, which increases their negative effect on originally discharged pollutants. If there are no external sources from which polluting substances arrive, there will be with time a dynamic balance in which "arrival" and "expenditure" of pollutants in a particular component of the environment compensate for each other. The proportions which were established during this process determine the field concentrations of pollutants, on which there also depends the state of the environment.

The principles of modeling the movement and conversion of pollutants are described in [27]. They are based on the use of the Monte Carlo method for "lottery drawing" of a uniform Markov chain. The proposed model contains many still unformalized assumptions and requires correspondending addition and expansion, which should be achieved not by complicating a chance process which lies at the base of the model, but rather by describing the geophysical, geochemical, hydrometeorological and other processes which exist in the environment. In other words, it is essential to have integration of the initial model with a class of specific models interrelated with the movement of substances which pollute natural processes, which in one way or another can influence the general level and structure of environmental pollution. A detailed description of models of this kind is not part of our purpose; for this reason we shall only note that according to [27], an m x n component vector will be determined at the output of a complex of models of the movement and conversion of pollutants

$$\hat{z}_k = (\hat{z}_{1k}, \ldots, \hat{z}_{qk}, \ldots, \hat{z}_{mk}), \quad k = 1, \ldots, n, \qquad (2)$$

where $\hat{z}_{qk}$ shows the concentration of type q pollutant in component k of the environment.

The presence of vector $\hat{z}_k$ makes it possible to move to the next, third group of models which are part of the system under consideration. In fact, the vector $\hat{z}_k$ is the yield of a group of models of industrial influence on the environment and provides essential information for modeling the dynamics of the elements of an ecological-economic system under the direct or indirect influence of external conditions which have changed. The extreme diversity in the composition and content of the elements of an ecological-economic system do not make it possible to propose here any kind of unified theory, much less cite

concrete models of their dynamics under the influence of a polluting environment. The material given below should be considered rather as principles or as an illustration of the methods for modeling dynamics from the viewpoint of a total concept of building a system of ecological-economic models. Developing them is a prolonged, labor-intensive process which requires that specialists be attracted from various branches of science; it also requires a particular organization of work and its own specific methodological, informational, technological and other forms of support.

In modeling the dynamics of production factors under the direct or indirect influence of a polluted environment, we shall single out three subgroups: the means of production, natural resources and labor resources.

For obvious reasons it is natural to assume that the study of the dynamics of the means of production under the influence of a polluted natural environment is the simplest task, if not in a quantitative sense, then at least in terms of content. We shall examine ways to solve it using as an example one model for the study of the dynamics of fixed capital. We shall use Φ_i' to designate that fixed capital i has been put into operation and Φ_i'' to indicate the withdrawal of fixed capital at this particular moment in time. The increase in fixed capital at moment t is then equal to

$$\Phi_i(t) = \Phi_i' - \Phi_i'', \quad i = 1, \ldots, n. \tag{3}$$

We shall take further advantage of the system of differential equations which characterize the speed at which capital is put to use and retired

$$\begin{aligned} \frac{d\Phi_i'}{dt} &= f_i'(\Phi_i', \Phi_i'', \hat{Z}_k), \\ \frac{d\Phi_i''}{dt} &= f_i''(\Phi_i', \Phi_i'', \hat{Z}_k), \quad i = 1, \ldots, n. \end{aligned} \tag{4}$$

where $\hat{Z}_k$ is a vector, which reflects the level of environmental pollution. Then

$$\frac{d\Phi_i}{dt} = f_i'(\Phi_i', \Phi_i'', \hat{Z}_k) - f_i''(\Phi_i', \Phi_i'', \hat{Z}_k). \tag{5}$$

If the values are known for Φ_i' and Φ_i'' at any moment t and for every component of vector Z_k at that moment, and if the form of functions f_i', f_i'' and $\Phi_i(t_0)$ is known, then the law for the change in the magnitude of fixed capital $\Phi_i(t)$ can be determined. Let us say that the form of functions f_i' and f_i'' is known, then the system (4) formally makes it possible to obtain solutions which determine Φ_i' and Φ_i'' as functions from $\hat{Z}_k$, i.e.,

$$\begin{aligned} \Phi_i' &= g_i'(\Phi_i', \Phi_i'', \hat{Z}_k), \\ \Phi_i'' &= g_i''(\Phi_i', \Phi_i'', \hat{Z}_k), \quad i = 1, \ldots, n. \end{aligned} \tag{6}$$

by substituting these solutions in (5) and applying simple transformations for $\Phi_1(t)$, we shall obtain

$$\Phi_1(t) = \Phi_1(t_0) + \int_{t_0}^{t} G_1(\Phi_1'(t_0), \Phi_1''(t_0), \hat{Z}_0)\, dt \qquad (7)$$

It is obvious that the left part of (7) is a function from $\hat{Z}_0$; consequently, (7) makes it possible to study the behavior of $\hat{\Phi}_1(t)$ with various predictive values for this vector. Knowing the nature of the influence which a polluted environment exerts on fixed capital, any increase in the absolute values of $\hat{Z}_0$ components or in the duration of influence of identical concentrations of pollutants should be viewed as supplementary damage, i.e., an increase in the rate at which fixed capital is retired. This interpretation of the damage from environmental pollution can create the impression that in order to study the dynamics of fixed capital it is sufficient to know only the dynamics of the dependence $\Phi_1''(t)$. This would be correct if the ecological-economic system had no environmental protection activity; the dependence of the rate at which capital is put into operation on the level of pollution is obvious. In this way, the model under consideration is more general in nature.

In the absence of compensatory measures the influence of a polluted environment on the means of production leads to a reduction in the production volumes and, consequently, to a reduction in industrial emissions into the environment. In this way the environment has a regulating effect on production. In this case economic damage acts as a parameter of regulation: the loss of means of production due to an increase in the rate at which they are retired due to the intensification of processes of deterioration, corrosion, wear, reduction in quality and other consequences of the effect of harmful substances in the environment. Various methods for taking into account a regulating parameter of this type within the models of economic activity are treated in [1, 4] and will be discussed below.

More complex tasks arise during the attempt to model the dynamics of natural resources. As was noted, the presence and state of natural resources is predetermined by the state of the environment, i.e., the study of the dynamics of natural resources presumes preliminary study of the change in environmental states after by-products of production are discharged into the environment. It is significant that in this case the vector $\hat{Z}_0$ is a completely acceptable description of the quality of the inorganic natural environment. This makes is possible to study the dynamics of a number of inorganic natural resources (processes) with the help of various modifications of the models analogous to (3)--(7) [5]. Another, biotic (organic) portion of the natural resources requires a different approach, a specific one which is described below in a manner which is by no means comprehensive.

We shall describe a simplified model of a natural ecosystem, which consists only of four elements [6]: autotropic plants (I), herbivorous animals (II), predators (III) and parasites (IV), which consume the biomass of the first three groups of organisms. The equations of the balance of the living organic substances for this ecosystem are

$$\frac{dB_I}{dt} = P_I - \gamma_{II} B_{II} - D_I \qquad (8)$$

$$\frac{dB_{II}}{dt} = P_{II} - \gamma_{III} B_{III} - D_{III} \qquad (9)$$

$$\frac{dB_{III}}{dt} = P_{III} - D_{III} \qquad (10)$$

where B_I, B_{II} and B_{III} are the biomass for the corresponding group of organisms on a unit of the area which they occupy; P_I, P_{II} and P_{III} are the productivity or the amount of biomass coming in within a unit of time from which the expenditure for the life activities of the organisms is subtracted; D_I, D_{II} and D_{III} are the consumption of biomass by parasites and γ_{II} and γ_{III} are the coefficients which characterize the biomass consumption of organisms by representatives of the II and III groups per unit of their mass.

Equations (8)-(10), while taking into account the coefficients γ_{II} and γ_{III} by means of constants, contain nine unknowns. Consequently, in order to solve them it is essential to compile on the basis of empirical data six additional ratios, which, along with consideration for the environmental pollution level, can be represented as

$$P_I = P_I(B_I, B_{II}, Z_k), \qquad (11)$$

$$P_{II} = P_{II}(B_{II}, B_I, B_{III}, Z_k), \qquad (12)$$

$$P_{III} = P_{III}(B_{III}, B_{II}, Z_k), \qquad (13)$$

$$D_I = D_I(B_I), \qquad (14)$$

$$D_{II} = D_{II}(B_{II}), \qquad (15)$$

$$D_{III} = D_{III}(B_{III}). \qquad (16)$$

Relationships of the type P_I (B_I, B_{II}), P_{II} (B_{II}, B_I, B_{III}), P_{III} (B_{III}, B_{II}) have been well studied in ecology and have a quite definite interpretation. In contrast to this, the determination of the nature of the relationships P_I (Z_k), P_{II} (Z_k), P_{III} (Z_k) requires additional empirical research for various ecosystems. However, only in this way can dynamics of the biomass of the system's components be studied, taking into account the factors which influence it. In fact, while solving system (8)-(10) along with the additional relationships (11)-(16), the size of the biomass for each group of organisms can be determined for every moment t, taking into account the trophic structure of the community and the influence of a polluted environment on it. It is natural to assume that with modifications in the values of the Z_k components or in the extent of the influence of that level of environmental pollution there are corresponding changes in the biomass values of the ecosystem's components. We shall examine the significance (for production) of the consequences of these changes.

Let us say that the ecosystem has industrial significance, i.e., that its biomass or the biomasses of individual components serve as the raw materials for production of material benefits and are also used to destroy harmful by-products. Taking into account the negative influence of a polluted environment on the productivity of individual components of the ecosystem, the change in the use (for production purposes) of the biomass of a concrete type can then be portrayed by the balanced ratio

$$B(t) = \sum_{i=1}^{n} r_i x_i + \sum_{\beta=1}^{m} r_\beta y_\beta + \sum_{\gamma=1}^{k} r_\gamma z_\gamma. \qquad (17)$$

where r_i, r_β are the coefficients of biomass expenditure in the corresponding spheres of activity; r_γ is the coefficient which shows losses (deficiencies) of biomass due to environmental pollution; B (t) is one of the components of the total solution of the system of differential equations (8)-(10).

In this way, the last sum in (17) takes into account the natural damage from environmental pollution and introduces a correction factor into the balance of the production use of given type of natural resource. The coefficient r_γ can be determined on the basis of the ratios (11)-(13), which were compiled on the basis of empirical data for the different moments t' and t", which are characterized by non-identical levels of pollution or by a differing extent of the influence of equal concentrations of harmful ingredients.

It is easy to note that equations (8)-(17) formally describe a closed loop, which is formed in an ecological-economic system, given the realization of a direct relationship which is caused by a flow of industrially generated wastes, and negative feedback as a consequence of the effect of a polluted environment on production through natural resources. The result of this kind of description is the determination of the natural damage from environmental pollution; the damage is taken into account in the balance of the productive use of resources. Consequently, the loss of the latter is the next parameter which characterizes the regulating effect of the environment on those large-waste production units which pollute.

We shall now examine the changes in the biomass of the ecosystem's components from the viewpoint of the environment's qualitative state, which is understood not only in the sense of the purity of its inorganic components, but also in the sense of the composition of natural ecosystems which comprise it. Every ecosystem, every natural complex reacts to external influences in its own way so that what is described below should once again be taken to be the principles of construction and not a list of the concrete elements of one of the most important and complex subsystems of a system of ecological-economic models for planning and managing the state of the environment.

According to the theory of ecosystem stability, changes in the biomass of its individual components which exceed the permissible deviations from their values for a stationary state lead to the destruction of these components. In fact,

this is the equivalent of destroying a given ecosystem. However, in general, the reaction of a system to the influence of a polluted environment does not end here: the place of the destroyed components is taken by other components which are better adapted to the new conditions. There begins the process of the so-called exogenous succession, as a result of which an ecosystem is formed with a qualitatively new composition which, as a rule, is lower than the former one [7, 8].

In nature all processes and phenomena are interrelated by various bio-geochemical cycles; they do not exist separately. Consequently, quantitative changes in an ecosystem or in its individual components can become the reason (the start) of more profound ecological transformations, which reflect negatively on the qualitative state of the environment. The dynamics of these kinds of global cycles (the water cycle, the carbon dioxide and oxygen cycles, etc.) under the influence of a polluted environment can be studied by using various modifications of type (3)-(7) systems, which are considered together with relationships of the (8)-(16) type and with models of exogenous succession. It is clear that information models of natural complexes should be included here inasmuch as the opinion exists that a thorough idea of the dynamics of the biosphere under the influence of industrially-produced wastes can be obtained only on the basis of the aggregate of the models which reflect the transformation in nature not only of matter and energy by also of information [9]. Naturally, a final enumeration of the groups of models which describe qualitative changes in man's environment can be established only in the course of specific elaborations with consideration for all of the diversity of the natural processes and phenomena. This interdisciplinary problem cannot be solved immediately through the efforts of specialists from one discipline; it requires instead the specific organization of labor by specialists of various types and various disciplines [10].

Let us assume that the totality of these models exists, and we can predict the qualitative state of the natural environment into which it is transformed under the influence of the vector $\bar{z}_k$ for the concentrations of pollution. Let us turn to the principles for taking into account and evaluating the influence of the new, qualitative state of the environment on the economic requirements of the population and on the presence and state of labor reserves. We shall introduce the line vector

$$E=(e_1,\ldots,e_M;\ \bar{z}_*). \tag{18}$$

the component of which e_l, $l=1,\ldots,M$ is a definite ecological parameter, which describes the state of the biotic portion of the environment from the viewpoint of the "free" benefit l, which is granted by the environment to man. $\bar{z}_*$ is the well-known vector which shows the state of the inorganic components of the environment in this same aspect.

Let us further assume that the presence and state of the labor reserves depends on the size and health of the population. Proceeding from the goals of the investigation, and also from the premise that the relations and interrelationships of man and nature are constant and find reflection in human health [11], we shall limit ourselves to taking into account only the influence of ecological factors on man's health, i.e.,

$$L(t)=L(N, E). \tag{19}$$

where $L(t)$ is the presence of labor resources at moment t; N is the size of the population; E is the vector which is determined by the relationship (18).

The size of the population N(t) is seen as an exogenous variable, the significance of which is revealed in a set of prognoses for an integrated system of models for economic planning and prognostication [3]. Prognoses of labor resources are also carried out here. The task of the system of ecological-economic models consists in the realization of the relationship L(E), the nature of which can be established only with study of the biological reactions of man to the influence of ecological factors and with analysis of the mechanisms of these reactions [12]. The determination of the optimal values of the parameters of vector E, which would correspond to the above-cited understanding of man's health, must be the result of the solution of this problem.

In the future we shall view any deviation from E_{opt} as losses of labor resources related to temporary inability to work due to illness, to reduction in labor productivity, to premature death and to other consequences of environmental pollution. The influence of a polluted environment on the health of those members of the population who are not able to work at a given moment in time must also be reflected in these losses. This is completely justified because the influence of the environment on this part of the population will be reflected in the total volume of the consumption fund through an increase in the demand for medical services. The increase in the total volume of the consumption fund will create an additional shortage of labor resources.

We shall designate losses of labor resources due to environmental pollution with $\Delta L(t)$. Taking into account that which has been described, these losses can be represented with the obvious relationship

$$\Delta L(t) = L(N, E_{opt}) - L(N, E) \qquad (20)$$

In principle (20) makes it possible to determine the coefficients l_g, which characterize the losses of labor resources per unit of a given type of pollutant in the environment. In turn this provides an opportunity to describe the change in the use (without taking into account the environmental pollution factor) of predictive amounts of labor resources by the balanced equation

$$L(t) = \sum_{i=1}^{n} l_i x_i + \sum_{g=1}^{m} l_g \theta_g + \sum_{q=1}^{m} l_q \tilde{z}_q. \qquad (21)$$

where l_i, l_g are the norms for labor intensity in the sphere of goods production and environmental protection activities respectively. Equation (21) shows clearly that the loss of labor resources due to a worsening of the state of the population's health is a third factor which exerts a regulating influence of a polluted environment on production. This influence (the reverse link) is the main one and the most complex influence in a given ecological-economic system. It has been little studied in practice because it does not lend itself easily to formalization, although certain studies show that this problem, too, can--within certain limits--be resolved successfully (see, for example, [13, 14]).

Let us turn to the models of the first group which describe the process of public production. All the necessary prerequisites for this have been prepared: a model (1) of the dynamics of the industrially-produced wastes which are being discharged into the environment provides the start of the forward link, while the two reverse link loops, studied later, are related through the magnitude of the losses (natural damage) of natural and labor resources respectively, which are integrated into balanced relations (17), (21). In essence these are

detailed and linked (by means of the environment) secondary output and two inputs of a production subsystem, which is viewed according to the "black box" principle. In order to close the loop it is essential to describe the essence of the transformations of inputs into output which are taking place within it. It is natural to assume that this can be done in various ways. However, the need to take into account the environmental pollution factor limits the opportunity for the direct utilization of existing economic-mathematical models without making preliminary modifications in them. While wishing to demonstrate simultaneously both the first and the second, we shall take advantage of the dynamic equation for expenditures-output [17]

$$x_i - \sum_{j=1}^{n} a_{ij}x_j - \sum_{g=1}^{m} a_{ig}y_g - \sum_{q=1}^{m} a_{iq}\hat{z}_q - \sum_{j=1}^{n} k_{ij}\frac{dx_j}{dt} - \sum_{g=1}^{m} k_{ig}\frac{dy_g}{dt} - \sum_{q=1}^{m} k_{iq}\frac{d\hat{z}_q}{dt} = c_i, \quad i=1,\ldots,n, \tag{22}$$

where x_i is the gross output of product i; y_g is the volume of destructible pollutant g; $\hat{z}_q$ is the volume of pollutant q found in the environment; a_{ij} and a_{ig} are the corresponding norms of material intensity; a_{iq} is the coefficient which describes the losses of product i per unit of pollutant q found in the environment; k_{ij}, k_{ig} are the coefficients of the increasing capital intensiveness in the sphere of manufactured goods production and the destruction of pollutants respectively; k_{iq} is the coefficient which reflects losses of capital due to an increase in the volume (reserve) of pollutant q during the period t; c_i is the pure end product of type i.

Equation 22 shows the dynamics of expanded reproduction of commodities with consideration for commodity requirements for the destruction of harmful production wastes and the replacement of losses related to the influence of a polluted environment on the means of production. It is related to (1) in terms of the first two variables and takes into account on the basis of these same variables the limiting influence of the relations (17) and (21). Consequently, (22) corresponds to the previously formulated requirements and it describes to a sufficient degree the models isolated in the first group.

In order to provide a general idea of the advisory models it is essential to examine the principles of the functioning of the system of ecological-economic models within the process of planning and managing the state of the environment.

There is no doubt that the past history of the ecological-economic calculations according to the proposed system of models must begin with a prediction of its exogenous variables; the size of the population, the volume and structure of labor and natural resources, the antonomous function of the pure end product $c_i(t)$, which reveals goal-oriented directives for economic growth within the dynamic model (22). From an ecological viewpoint, models (22), (1) transform these special purpose directives into the vector of industrially produced emissions z_q which in turn are transformed as a set of models for the movement and conversion

of polluting substances into a vector of pollution concentrations $\hat{z}_q$. This is used in preparing an information base for predicting the dynamics of the qualitative and quantitative states of the biosphere, the dynamics of the means of production and inorganic natural resources, the health of the population and the dynamics of the volume of labor resources under the influence of a polluted environment. Examples of typical models of a given group were examined above.

Determination of the vector for the magnitude of various types of natural losses of damage from the influence of harmful, industrially-produced emissions is a result of modeling the dynamics of the elements in an ecological-economic system. In order to cite these heterogeneous values in terms of a single measurement, it is necessary to evaluate labor and natural resources which in one way or another change their state under the influence of a polluted environment. From a mathematical viewpoint the need for evaluations of this kind is justified in [4] with the formulation of the task of ecological-economic equilibrium as the direct and dual tasks of linear programming with the assigned system of social priorities in the form of aggregated functions of demand for the production of commodities, the elimination of harmful secondary production and the functions of supplying primary resources. Significant aspects of these evaluations are examined within the theoretical elaborations of the problem of the optimal functioning of the economy. From the viewpoint of ecological-economic planning and management their existence would make it possible to shift to a single indicator for damage from environment pollution--to the hidden social costs of production.

The authors of the present article have developed a dynamic criterion for optimal environmental pollution activities, a criterion which makes it possible to determine the economically substantiated hidden costs of production [1]. The essence of it is the comparison of expenditures for the destruction of pollutants with the effect obtained from it. In the formal expression the criterion for optimal functioning can be presented in the form of a non-homogeneous system of linear differential equations

$$\frac{dy_q}{dt} + \alpha_{qq} y_q = \beta_q (\hat{z}_q' - \hat{z}_q''), \quad q, g = 1, \ldots, m, \tag{23}$$

where α_{qg}, β_q are non-negative coefficients; $\hat{z}_q'$, $\hat{z}_q''$ are two different type q pollutants which differ in terms of the total volume of the field of concentrations.

In essence (23) is an advisory model by means of which one can determine the economically substantiated volumes of destructible pollutants or the hidden costs of public production. Whether or not society agrees with these costs is a question which requires special consideration. In the given case it is important that (23) makes it possible to adopt one of several alternatives, which in the next analysis can serve as a kind of "reference point" when adopting other decisions. Moreover, in conjuction with (1) and (22),

equation 23 forms an integrated model, which makes it possible to obtain balanced values for the variables which are part of it when given: the intensities of the final consumption, the level of environmental pollution and limited labor and natural resources. These values reflect the interactions of the flow of products, environmental pollutants, and capital investments, primarily in the production sphere, which are essential to ensuring the output of a pure final product and to maintaining the environment in a desirable state. Consequently they can be used as monitor indices for compiling long-term plans for economic development, while taking into account ecological problems which have grown worse. In the future the values of these indices can be reexamined with consideration for new information on the state of the ecological-economic system at any moment t. These changes must find reflection in the disaggregated indices of long-term and short-term plans; thus the principle of management on the basis of a closed loop will be realized. And it is this principle which is at the heart of the process for designing the system described for ecological-economic models.

The inadequate developmental state of the system of ecological-economic models does not make it possible to cite at the present time a complete list of indicators for planning and managing the state of the environment. However, the main groups of indicators can be demonstrated on the basis of the cited loop for this kind of system. They amount to the indicators which describe the primary funds for activities to protect the environment from pollution, in the industrially-produced influence on the environment; the state of the environment; the hidden social costs of production; the effect (expressed in natural and cost terms) of improving the state of the environment.

The first three groups correspond to a certain degree to the indicators used in current practice in planning environmental protection. The indicators of the last two groups, in our opinion, must provide for the integrability of environmental protection measures and the targets of other sections of economic development plans. For example, inclusion of hidden social costs of production in the production costs of an enterprise according to its "contribution" to environmental pollution on the one hand, and planning profits and profitability with consideration for the benefit obtained from improving the environmental state in general, on the other hand, can exert a positive influence on the realization of natural protection measures which are being planned.

The above does not exhaust all the problems related to the construction and practical use of a system of ecological-economic models for purposes of planning and managing the state of the environment; only the outlines of this kind of system have been examined, along with individual units which are distinguished by the depth of their scientific and methodological elaboration. Some of the methodological premises which are fundamental to the investigation and interpretation of both economic as well as purely ecological processes and phenomena may prove to be controversial.

FOOTNOTES

1. Naturally environmental pollution also exerts a direct influence on labor resources. Other factors which are external with regard to the system under consideration are not taken into account in this case.

2. This is an assumption equivalent to excluding the influence of scientific-technical progress on the dynamics of industrially-produced discharges.

3. As already noted, these benefits may be clean air, fresh water, the aesthetic value of the scenery, the value of the landscape for maintenance of health, and recreation and others related to man's ecological requirements.

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ENVIRONMENTAL EQUIPMENT INDUSTRY EXPORTS TECHNOLOGY, EXPERTISE

Copenhagen BERLINGSKE TIDENDE in Danish 29 Jun 81 Part II p 1

[Article by Kirsten Sorrig]

[Text] Other countries are standing in line to acquire Danish know-how on chemical waste and pollution control. The Danish firm Chemkontrol, Inc. has talked with many eastern and western countries about delivering a set-up similar to Kommunekemi. It should also be possible to exploit the experiences gained from Cheminova commercially.

"We are already working on building a system like Kommunekemi in Finland and have talked to authorities in the USSR, the United States, Hong Kong, Canada, Norway, Belgium and Ireland about similar projects," director Poul Vermehren of Chemkontrol, Inc. and I. Krueger told the BERLINGSKE TIDENDE business section.

The foreign authorities are interested in help with building plants based on the same principles as Kommunekemi but adapted to the special needs of the individual country or city.

"Surprisingly enough Denmark and Vienna, the capital of Austria, are the only places in the world where there is organized pollution control and definite guidelines for waste treatment. But environmental protection is becoming a top priority everywhere in the world and this is really an area where we are leaders and have something to offer," said Poul Vermehren.

Subcontractors

He estimated that within 1 or 2 years Denmark will have an annual income of 25 million kroner from exporting pollution know-how.

"The annual income from consultant fees will be between 4 and 5 million but in addition to that Danish contractors and subcontractors will earn around 20 million kroner from exports," he said.

Even though there is more interest in Kommunekemi experiences from Cheminova will also be valuable. In this connection the director of the Environmental Agency, Jens Kampmann, said:

"There is no doubt that the experiences gained from Cheminova will be useful commercially. The stored poison will be removed this week and the excavation has gone much better than we expected. This is being followed with great interest abroad for other countries have similar or even greater problems with poison storage dumps but lack a good way to solve them."

More Cases Coming

Jens Kampmann said there would be many "Cheminova cases" in the future both in Denmark and in other countries.

"Therefore it is important that we try to keep the leadership position we now have internationally in combatting pollution and treating chemical waste," he said.

Even though the excavation of the poison dump has gone better than expected the waste problem in that case has still not been solved. The West German regional authorities in Hessen have not yet given permission to have roughly 4000 t[illegible]s of excavated poison from Cheminova stored in an abandoned salt mine.

"But we are expecting a reply from the German regional authorities within the next few days," Jens Kampmann said.

Director Named

At Chemkontrol the recent reports of the Cheminova case in foreign papers have stirred increased interest in finding out how Denmark is trying to solve the big pollution problem in Vendsyssel.

"We've been so busy we are naming our own director to start on 1 July. Chemical engineer Peter Lovgren will be the daily leader in the future," said Poul Vermehren who has been designated director since the firm started 1 1/2 years ago but is also director of I. Krueger.

Chemkontrol was started by I. Krueger, Kampsax and Kommunekemi, each of them with a third ownership of the stock capital. In addition the Environmental Agency is represented on the board of directors which consists of Knud Ostergaard, chemical professor at Denmark's Technical College, director Erik Norsk of Kampsax, director Poul Vermehren of I. Krueger, director Willy Brauer of Kommunekemi and director Jens Kampmann of the Environmental Agency.

Chemkontrol has only three employees but has indirect access to all employees of Kampsax, I. Krueger and Kommunekemi, giving it an actual staff of around 1000.

"The project leader puts together a group of experts for each job. The problems we are asked to solve are extremely varied so it is an enormous advantage to be able to draw on so many different specialists," Poul Vermehren said.

The first big job Chemkontrol had was to make a Kommunekemi plant for Finland. The first phase of the project is finished and Poul Vermehren said the plant would be ready for use sometime in 1983.

Many Projects

The next big project will be for the Canadian province of Ontario where Chemkontrol has become a consultant to the province and plans to design a Canadian Kommunekemi with the help of a local engineering firm.

"At present we have big expectations with regard to a similar project in Hong Kong. We have negotiated for some time and expect results in 2 or 3 weeks," said Poul Vermehren

The United States has just tightened its environmental protection law and this has led to many contacts from American states and cities who want to make use of Danish know-how.

"Although the United States is a technologically highly-developed country it is far behind Denmark with regard to fighting pollution," Poul Vermehren said.

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CONFERENCE ON PHENOXY COMPOUNDS SEES INCREASED HAZARDS

Stockholm DACENS NYHETER in Swedish 3 Jul 81 p 9

[Article by Bog Andersson: "Phenoxy Acids May Cause Nerve Damage"]

[Text] People who often come into contact with phenoxy acids run the risk of serious brain and nerve damage.

So says the Dutch psychiatrist Cees van Tippelen, who is taking part in the world congress of biologic psychiatry, under way in Alvsjo this week.

Cees van Tippelen has studied phenoxy acids 2.4 D and 2.4.5 T. A weed killer, 2.4 D is used extensively in Swedish agriculture, forestry, and home orchards; 2.4.5 T has been banned since 1977. Cees van Tippelen conducted his research in Australia, where he studied a group of farmers and Vietnam war veterans. Both 2.4 D and 2.4.5 T was used in large amounts by the United States in Vietnam during the war, with large parts of the country being defoliated.

The studied persons (20 farmers and 20 war veterans) all had such lengthy contact with the phenoxy acids that they have become ill.

Van Tippelen found that they often suffered from loss of memory, loss of sexual urge, and has reduced tolerance of alcohol. In addition they showed reduced zinc levels, increased copper levels, and low selenium levels.

Van Tippelen believes that the poisonous compounds under certain circumstances can redistribute the heavy metals in the body so that the nervous system and the brain are damaged. This applies in particular to copper.

In van Tippelen's opinion, people who have in their bodies high contents of copper, arsenic, and mercury are more at risk than others.

The Nature Protection Administration regards these new experiences as "very interesting."

Bo Wahlstrom, section chief of the NPA's product control bureau, says to DAGENS NYHETER:

"We study all research on phenol oxide acids carried on abroad, but have never before encountered information on the effect of the substances upon the human nervous system. We have not yet been able to study van Tippelen's results, but will do so as soon as we can. Until that time we shall have to defer further comment."

Intensive Debate

The discussion on phenoxy acids has been intensive during the past decade, but what above all has been the burning issue is the connection between phenoxy acids and cancer.

The new information on disturbances of the nervous system in humans can therefore furnish environmental protection groups additional arguments in their fight against spraying of fields and forests. The phenoxy acids are far from completely researched, and many different projects are underway in the world.

As recently as 23 May of this year DAGENS NYHETER reported that 2.4 D compounds might contain remnants of the dangerous and carcinogenic poison dioxin. It was the Nature Protection Administration itself that demonstrated the presence of dioxin in the preparations sold in the Swedish market.

The ministry of agriculture is at present working on a proposal for a law dealing with spraying in forests. It will be presented this fall, and Anders Dahlgren, minister of agriculture, has announced a more restrictive attitude toward the poisonous sprays.

In 1979, 71,000 kilograms of 2.4 D were sold in Sweden. About one half, 40,000 kilograms, was in 1979 used for combating leafy growth in forests. The remainder was sprayed on tilled fields (27,000 kilograms) and on orchards (4,000 kilograms.)

Pending the government's proposed law, last year's ban on spraying the forests has been extended over this year's season in August and September.

On the other hand in farming and horticulture spraying is going on as before, and no new initiatives by the government are expected.

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BRIEFS

PHENOXY COMPOUND USE RESTRICTED--Use of phenoxy compounds for control of deciduous forest growth will in general be restricted, but dispensation from the rule will be possible. The Forest Protection Administration will probably be given authority to grant dispensation, but municipalities will have an influence. So says Agriculture Minister Anders Dahlgren to SVENSKA DAGBLADET. "A complete ban on spraying is impossible," he adds, "for there are remote areas with very difficult terrain, where people cannot be brought in for manual clearing, or where the work would be inhumanly demanding." In December of last year an analysis of the problem proposed giving the phenoxy compounds the green light, but with certain areas excepted under clearly given conditions. A ban on the use of phenoxide compounds in agriculture is not being considered. One reason for this is that the law does not permit the public to set foot on cultivated fields. A law will be probably proposed to the Riksdag in the fall. Work on it has begun in the ministry. [Text] [Stockholm SVENSKA DAGBLADET in Swedish 25 Jun 81 p 6] 11,256

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